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(54) **NON-CONTACT ROTATIONAL POSITION  
SENSOR AND THROTTLE VALVE  
ASSEMBLY INCLUDING NON-CONTACT  
ROTATIONAL POSITION SENSOR**

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123/406.52**

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(56) **References Cited**

**U.S. PATENT DOCUMENTS**

5,444,369 A \* 8/1995 Luetzow ..... 324/207.2  
5,528,139 A 6/1996 Oudet et al.

5,789,917 A 8/1998 Oudet et al.  
6,137,288 A 10/2000 Luetzow

# FOREIGN PATENT DOCUMENTS

|    |         |         |
|----|---------|---------|
| JP | 2842482 | 6/1996  |
| JP | 2920179 | 8/1998  |
| JP | 2842482 | 10/1998 |
| JP | 2920179 | 4/1999  |

\* cited by examiner

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(57) **ABSTRACT**

A non-contact sensor for sensing a rotational position of a rotating object is provided. A ring-shaped permanent magnet magnetized in the axial direction is sandwiched between two pairs of magnetic plates from above and below. Two pairs of upper and lower protruded magnetic substance portions are provided between the upper and lower magnetic plates at opposite outer ends thereof. Magnetic sensitive devices are inserted in air gaps between the two pairs of upper and lower protruded magnetic substance portions. A magnetic flux generated from the ring-shaped permanent magnet is substantially concentrated to the protruded magnetic substance portions and passes the magnetic sensitive devices. The amount of magnetic flux passing each magnetic sensitive device is substantially proportional to the rotational angle of the ring-shaped permanent magnet. The rotational position of the ring-shaped permanent magnet and hence the rotational position of a rotating shaft supporting the ring-shaped permanent magnet can be sensed in a non-contact manner as a signal output from the magnetic sensitive device. Since the magnetic flux is effectively concentrated to positions where magnetic sensitive devices are attached, a non-contact rotational position sensor having high accuracy and high sensitivity can be obtained.

**8 Claims, 18 Drawing Sheets**

